Production of drink cans from metal sheet, especially tin plate

Publication number: DE19802953 (A1)
Publication date: 1999-07-29
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Classification:
- international: ***B21D51/26; B29C47/02; B65D1/16; B65D8/02; B65D8/12; B65D8/20; B65D41/34;*** *B32B37/15;* **B21D51/26; B29C47/02; B65D1/00; B65D8/00; B65D8/04; B65D41/34;** B32B37/14; (IPC1-7): B65D8/02; B65D8/20; B21D51/26; B29C47/02
- European: B21D51/26; B29C47/02; B32B37/04; B32B37/08; B65D1/16B; B65D15/10; B65D41/34
Application number: DE19981002953 19980127
Priority number(s): DE19981002953 19980127

Also published as:
DE19802953 (C2)

Cited documents:
DE4029553 (A1)
DE3105528 (A1)
AT321694B (B)
US4541546 (A)
EP0168070 (A1)

Abstract of **DE 19802953 (A1)**

Tin plate drink cans are made by deep-drawing and ironing a circular blank to form an open cylinder with a domed top, punching a hole in the dome, fitting a resealable closure with a screw cap in the hole and closing the open end with a flat round metal base by flanging and folding to form a double fold. A process for the production of drink cans from sheet metal, especially tinplate, comprises: (a) making a circular blank, forming this by deep drawing and ironing to a cylindrical body open at one end, with a cylindrical wall and an outward-curved dome-shaped end (top); (b) punching out a hole in the center of the top; (c) fitting a resealable closure system with a screw cap into the hole; and (d) closing the open end of the can with a separate, essentially flat, round metal base by flanging and folding to form a double fold.

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The invention concerns a procedure for the production of a beverage box out of sheet metal, in particular tinplate.

Beverage doses are usually manufactured made of tinplate or aluminum. Nowadays mainly two-piece doses are used, which consist of a lower part and a cover. The lower part is einstückig and consists of an essentially cylindrical dose wall, with a dose bathing angeformten to it. By deep-drawing and Abstreckziehen on those in the following described way is manufactured. From a broad strip a circular washer, Ronde is called, cut out. From this Ronde first a cup is pulled by deep-drawing. This cup must between soil and cylindrical wall an essentially kegelstumpfförmigen transition, also bevel mentioned, exhibit, so that the actual dose soil in the finished condition exhibits a diameter, which is smaller than the diameter of the cylindrical dose wall. The production of this bevel prepares large problems with the deep-drawing, because secondary folds can occur. These secondary folds arise increasingly, if for the material saving and for the decrease of the weight of the box sheet metal with smaller initial thickness and at the same time higher firmness is used. Thin sheet metal thicknesses and higher strengtheningnesses lead to the increased secondary formation of wrinkles. After the deep-drawing of the cup by Abstreckziehen the cup height is increased around for instance the three-way, as the cylindrical wall of the cup in the length is stretched and accordingly reduced in the thickness. The high surface pressures in the Abstreckwerkzeugen (stamp and rings) would before destroy a lacquer finish applied on the sheet metal, so that one done without pre-coating and the interior and external finish take place only at the finished box. At the end of the Abstreckvorganges the dose soil is formed into its final form, as the Abstreckstempel dives into the dose soil and a soil tool (stencil), present outside of the dose soil. Here inward a cathedral curved to the dose inside is produced, which changes at its outside edge into a circular placing edge. On this placing edge then outside the finally formed bevel borders. By means of air pressure, which affects the inside of the dose soil, and/or by means of stripping fingers, the finished lower part is stripped by the Abstreckstempel. In order to be able to use from cost reasons a cover as possible as small in the diameter, for whose production fewer sheet metal one needs, the diameter of the upper, open end of the lower part is made smaller by Necken. Before the Necken the lower part on the exterior and on the inside a spraying lacquer finish receives a primer and printing on. After all painting processes a drying process is accomplished. Ruch with water-soluble lacquers results in each case solvents.

The use of beverage doses from tinplate in damp-tropical countries represents a problem for corrosion reasons at the dose soil because of scratching the lacquer.

In Japan there are also beverage doses, which have reciprocally a plastic coating from PET (polyethylene terephthalate). The plastic coating is applied on a chromed broad strip (ECCS) before the dose manufacturing, which takes place usually via laminating a prefabricated foil. The lower part is manufactured by deep-drawing and far pulling with straining, whereby a wall thinning is reached from approximately 30 to maximally 50%. The reciprocal plastic coating does not permit the Abstreckziehen, because the plastic coating, in particular on the dose exterior, would fail. Bright, chromed sheet metal is not suitable for the deep-drawing and the Abstreckziehen, since Fresserscheinungen at the tools arise. The experiences and applied measures made with chromed sheet metal cannot be transferred so easily to tinplate, because plastic on chromed sheet metal clings better than on tinplate.

In US 4.541.546 is a two-piece beverage box made of sheet metal, z. B. Tinplate or aluminum plate, described. With an execution form of this beverage box an upper section is manufactured by deep-drawing and Abstreckziehen, which exhibits a cylindrical dose wall and an upper, domförmig outward curved conclusion wall. In the center of this upper conclusion wall itself a sleeve, similarly as a short bottle neck, extending outward from the conclusion wall, is angeformt. The production of this sleeve requires however several tools and work procedures, whereby total production costs of this beverage box are substantially raised the price of. The sleeve is to be locked by a cap or a plug, whereby not more near is described, as these parts are to look and cooperate with the sleeve. In addition upper section is connected with the lower part by overlapping gluing in the range of the cylindrical dose wall with this well-known beverage box. For this purpose the lower part is reduced in the diameter by Necken, so that it is insertable in upper section. For this the lower edge of the upper section is warmed up, in order to increase the diameter, and the edge of the lower part cooled down, in order to make its diameters smaller. As corrosion protection on the inside of the upper section and the lower part a lacquer is applied by spraying, dipping or electrostatic coating after the deep-drawing and Abstreckziehen.

From the DE 31 05 538 A1 a procedure for the production of metal containers is well-known, with which a metal blank made of electric furnace steel sheet metal is deformed by deep-drawing first to a on one side open hollow body with a radial flange and a cylindrical side panel. To impair by a following Abstreckziehvorgang then the side panel of the hollow body with simultaneous retention of the wall thickness extended without the deep-drawing condition of the radial flange. In the closed end of the hollow body also an opening is punched out and flanged. Finally on the open end of the side wall a catch element is put on, whereby both a deformation of the flange and the edge of catch element takes place. With this well-known procedure however no coated sheet metal is used and also no sealing system is inserted into the punched out opening.

The RK 321,694 concerns a procedure for the production of steel sheet containers from a deep-drawable steel, with which a Ronde is formed first with practically continuous wall thickness by in or multi-level deep-drawing procedure to a cup. This is brought by following Abstreckziehen to its wall thickness under decrease on the desired finished height. This block letters contain however no reference to special PET coatings, which get over a deep-drawing and a following

top Abstreckziehen without damage.

In the EP 0,168,070 A1 a procedure for the production of a container from steel sheet is revealed, with which into a *Endwand an opening is in-punched and put into these a catch element.*

From the DE 40 29 553 A1 a coated Metallblech is well-known for pulled doses, with which on a base metal biaxial a pulled polyester film under pressure and inserting of an adhesive layer is up-laminated. The production of a polyester film and the following thing Recken require however several jobs, before at all the film and/or. the foil on the broad strip to be up-laminated can.

Task of the invention is it to create a procedure particularly economical production of beverage doses from one with PET coated tinplate made possible.

This task is solved by a procedure with the characteristics of the requirement 1.

Favourable procedure measures are indicated in the Unteransprüchen.

With reference to the designs in the following the characteristics and advantages of the procedure are below more near described.

In Fig. 1 is partly in the profile, partly shown according to invention the new beverage box manufactured in the procedure in side view. It essentially consists of a dose body 1, a dose soil 2 and a again-lockable sealing system 3. The dose body 1 exhibits a cylindrical dose wall 4 and is at the one, upper end by with the dose wall 4 of a piece consisting, outward curved final part 5 locked, which forms the dose head. In the center of the domförmigen final part a central opening 6 is intended, which is formed by punching out. Into this opening the collet 7 is ago assigned from the inside of the dose body 1, which exhibits a flange 7a managing radially outward and at its neck part a screw thread 7b. On this screw thread the cylindrical *fuseholder 8 is from the outside ago screwed on.*

The cylindrical fuseholder 8 has a snap ring 8a, which is connected with the remaining cylindrical fuseholder by perforations, for the guarantee of the originality protection similarly as this with cover caps of Mineralwasserflaschen the case is. When first closing the cylindrical fuseholder 8 the snap ring behind one does not catch to the screw thread 7b belonging safeguard paragraph 7c at the collet, so that when late opening the cylindrical fuseholder the snap ring 8a is broken or torn off by the cylindrical fuseholder and one can recognize on the basis the torn off snap ring that the beverage box was already opened.

The lower, first open end of the dose body 1 exhibit a kegelstumpfförmigen section 9, which also introduction is called, for the decrease of the diameter D of the dose wall 4, and which is produced by so-called Necken. Z amounts to. B. the *diameter D of the dose wall 4 66 mm, then is reduced by the kegelstumpfförmigen section 9 the opening diameter D1 to* 57 mm or 52 mm. This takes place for the purpose that a dose soil 2 smaller in the diameter can be used. This dose soil 2 made of sheet metal is through connected to flanges and creases under production of a well-known double crease 10 with the dose body 1. Filling the box can take place either in such a way that first at its end open dose bodies 1 is filled with screwed on cylindrical fuseholder 8 standing on the head and up-folded then the dose soil the 2, or the dose soil before filling the beverage box can be up-folded and be filled the box then from the top by the collet through and be screwed on afterwards the cylindrical fuseholder 8. First has the advantage that a larger Füllgeschwindindigkeit of the beverage box is attainable.

The cylindrical fuseholder 8 with snap ring 8a and the collet 7 become preferably from plastic, z. B. PE (polyester) or PET (polyethylene terephthalate) manufactured. If necessary also tinplate or aluminum could be used.

Preferably the collet 7 with its flange 7a is stuck together because of the high dose internal pressures with the domförmigen final part of 5 or sealed with use of warmth. The flange 7a and also the snap ring 8a guarantee the corrosion protection of the lip of the opening 6, if the dose body 1 exists made of tinplate. Since that a seals at the bright or painted sheet metal would be afflicted with technical uncertainties, the dose body 1 at its inside should exhibit a plastic coating, with which further down standing one deals still more in greater detail.

The new beverage box can be manufactured made of tinplate, aluminum plate and other Metallblechen. Preferably however tinplate is used. For the production of the dose body 1 of a broad strip a circular washer, Ronde is called, cut out. The plate thickness of the Ronde, also tin-lined cases thickness mentioned, can amount to between 0,16 to 0.30 mm, preferably about 0.20 mm. By deep-drawing the Ronde becomes a simple, in Fig. 2 represented cup 1 ' with a height H transformed. When using tinplate the deep-drawing in or in two stages takes place with a Ziehverhältnis beta from 1,6 to 2,4. In such a way formed cup 1 ' becomes then by Abstreckziehen in three to four stages in Fig. 1 represented dose body 1 transformed, whereby the original cup height H is increased approximately around the three-way and with the Abstreckziehen the dose wall 4 thinner opposite the cup wall develops. With the Abstreckziehen the wall thickness of the cup, which corresponds to the original tin-lined cases thickness, with a strain is reduced phi to a third. The shaping of the first even cup soil to a domförmigen final part and punching out the opening 6 take place at the end of the Abstreckziehens, as the dose body is stripped by means of air pressure of the Abstreckstempel and the air pressure is used for it to press the final part of the dose body into a forming tool (stencil) with domförmiger recess. In principle a later external cathedral production is also possible in connection with the cutting of the opening. Possibly only after cutting the edge of dose, if the external cathedral in the existing machines disturbs. In this case the soil remains flat with the *Abstreckziehen. The dose body is made smaller afterwards at its open end by Necken in the diameter, so that in the* diameter according to smaller dose soil can be also used. An optimal utilization of material is reached by the Abstreckziehen. The thickness of the final part, which corresponds for instance to the original in tin-lined cases thickness and which is thickness of the dose wall, which amounts to for instance a third of the original tin-lined cases thickness, optimally the requirements adapted. In the range of the open end of the dose body the wall thickness is thickened around approximately 60 mu m opposite the remaining dose wall by the Necken.

If for the production of the dose body sheet metal without plastic coating is used, the dose body can after the Abstrecken and/or. Necken on the dose inside in the spraying procedure to be painted. More favourably it is however for the production of the dose body a sheet metal, in particular a tinplate to use which became to provide already before as broad strip with a plastic coating.

Because of the high pressures, which course-turned inside of the dose body arranged plastic coating with the Abstreckziehen between the stamp and that the stamp exist, only PET (polyethylene terephthalate) is applicable as coating plastic. In this case the Ronde from one is then punched out on one side with PET plastic-coated sheet metal and with the deep-drawing and Abstreckziehen the plastic-coated side the deep-drawing and/or. Abstreckziehstempeln course-turns.

After the Abstreckziehen then the entire inside of the dose body 1 is lined with a PET layer, like it in Fig. 1 is increased represented.

Appropriately a sheet metal is used, on which the PET layer was applied by direct extruding. By direct extruding of a liquid PET film on a broad strip heated up a particularly good adhesion of the PET layer can be achieved, what for the Abstreckziehen of substantial importance is.

In order to guarantee a high transforming ability of the PET, the PET layer should be brought appropriately in amorphous condition. This amorphous condition can be obtained by reheating of the coated broad strip on a temperature above the PET melting point and following fast deterrence in the Wasserbad. In order to keep the heating-up time as short as possible, the reheating can be caused by induction heating. The adhesion is improved in addition by the reheating. It is ensured by the amorphous PET layer that despite the high transforming demand no tears and pores in the PET layer arise.

In addition attempts showed that it is appropriate for the increased safety of the avoidance of pores and tears on production conditions to submit after the deep-drawing and before the Abstreckziehen the preformed dose body (cup) of a temperature treatment. This temperature treatment should take place at a temperature from 180 to 200 DEG C during one duration from 1 to 5 minutes. Since tinplate is a relatively inexpensive material for the production of doses, and PET the high demands with the Abstreckziehen resists, should for the execution of the procedure according to invention appropriately PET coated tinplate be used, with which the PET layer was applied by direct extruding.

For the dose soil 2 appropriately reciprocally with PET coated tinplate is used. PET is scratch-proof as a lacquer finish and forms for the dose soil outside at the placing edge 2a a durable corrosion protection. There is thus the beverage doses completely consisting of tinplate also applicable for subtropical countries.

It was found that during the coating of a broad strip a particularly good adhesion is reached if the broad strip on order behalf of the liquid Kunststoffilmes exhibits a temperature lying over the melting point of the respective plastic. The temperature of the broad strip should be appropriate for about 10 DEG over the plastic melting point. Since however the fusing temperatures of the different PET sorts lie between 230 and 280 DEG C, problems develop when the direct coating tinplate. The melting point of the tin may not be exceeded by 232 DEG C, since it comes otherwise to an iron tin alloy layer formation and in addition liquid tin with the feed roll would come with the extruding procedure into contact. Thereby the tin surface would be impaired and the tin could on the dose exterior the necessary lubricating action out with the Abstreckziehen not carry.

In order to achieve and on the other hand the tin layer of the tinplate not damage on the one hand the necessary high adhesion of the PET layer, therefore with the production of the plastic-coated tinplate it will proceed in such a way that between the tin surface and the PET layer an adhesion mediator from thermoplastic plastic is planned, whose fusing temperature <is/= 210 DEG C.

The PET and the adhesion mediator are applied appropriately by Coextrusion on the tinplate volume heated up, which was heated up on a temperature lying between the fusing temperature of the adhesion mediator and the fusing temperature of the tin.

Thereby it can be achieved that at a temperature of the tinplate volume on order behalf of the two-layered Kunststoffilmes of approximately 220 DEG C a damage of the tin layer is avoided, because this temperature is under the fusing temperature of the tin of 232 DEG C. On the other hand however the temperature of the tinplate volume lies around at least 10 DEG over the fusing temperature of the adhesion mediator, so that the desired good adhesion of the adhesion mediator at the tin surface is reached. The adhesion mediator guarantees the desired good group between tinplate and the PET layer lying outside. The thickness of the PET layer should at the time of the execution of the procedure according to invention about 10 to 50 mu m, which amount to the adhesion mediator about 5 to 10 mu m. The used tinplate has a thickness from 0,16 to 0.30 mm. The tin edition amounts to 1.0 to 5.0 g/m< 2> for each volume side, preferably 2.0 to 2.8 g/m< 2>.

The production of a PET coated tinplate, which is particularly suitable for the production of a beverage box in the procedure according to invention, becomes following on the basis the Fig. 3 described. A tinplate volume 11 is moved in its longitudinal direction and heated up first by a heating mechanism 12. By means of a slot die 13 a two-layered plastic film 14 is extruded, which consists of a PET layer 14a and an adhesion mediator layer 14b of thermoplastic plastic. The adhesion mediator 14b exhibits a fusing temperature, which is not larger than 210 DEG C. The tinplate volume 11 was heated up before in the heating mechanism 12 on such a temperature that it exhibits lying temperature of approximately 220 DEG C within the order range 15 of the liquid Kunststoffilmes 14 over the melting point of the adhesion mediator and under the melting point of the tin. The Kunststoffilm 14 is then pressed in slightly to the tinplate volume 11, by being passed through a gap between a feed roll 18 and a role 17, which are called Laminatorrolle. The Laminatorrolle 17 resting against the Kunststoffilm 14 thereby on a temperature one holds, which is under the fusing temperature of the PET. Appropriately the Laminatorrolle 17 should be held by cooling on a temperature within the range between 20 to 80 DEG C. The cooling of the Laminatorrolle 17 takes place favourably via water, which by the Laminatorrolle 17 one through-leads. Furthermore a guide roller 19 is intended, by which the tinplate volume 11 with at the Laminatorrolle 17 lying close Kunststoffilm 14 under tension over a part of the extent of the Laminatorrolle 17 is led around. Pressing the liquid Kunststoffilmes 14 to the tinplate volume 11 should take place with on the width of the tinplate volume a referred Kraft from at least 60 N/mm. While the Kunststoffilm 14 rests against the Laminatorrolle 17, at least its PET layer must be transferred by cooling into the solid state, before the surface of the Laminatorrolle 17 from the Kunststoffilm 14 is loosened. The diameter of the Laminatorrolle and/or. the Umschlingungswinkel, with which the tinplate volume as well as the Kunststoffilm 14 is held by the Laminatorrolle 17 in plant, it must be selected in such a way that at a volume speed of at least 50 m/min at least the layer of the PET with a cooling rate of at the most 400 W/m< 2> To cool down DEG C on a temperature, which is at least around 30 DEG C under the melting point of the PET, before the contact between Kunststoffilm and Laminatorrolle 17 is solved.

It proved as appropriate, if those is broader width of the slot die 13 than those of the tinplate volume. This leads to the fact that the Kunststoffilm manages 14 at each side of the tinplate volume around 20 to 30 mm.

The separation of the supernatant Kunststoffilmes takes place only after the cooling and hardening the plastic by means of the Besäumrollen 16, which are arranged at both sides of the coated tinplate volume.

As it was mentioned already further above it is important that the PET in an amorphous condition is present. For this purpose that PET coated tinplate volume by an induction heating mechanism 20 led, where it is brought on a temperature above the PET melting point. The excess of the tin melting point is not critical in this case, since because of the short

heating time the iron tin is very small alloy layer formation and the liquid tin does not come also with a role into contact. By direct introducing of the tinplate volume into a Wasserbad 21 the tinplate volume is finally deterred with high cooling rate on ambient temperature.

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1. Procedure for the production of a again lockable beverage box from tinplate, with the following process steps:
Punch out a Ronde from a tinplate coated on one side with PET, on which the PET layer was applied as follows by direct extruding:
a tinplate volume is moved and heated up in its longitudinal direction,
by means of a slot die a film is applied thermoplastic plastic, consisting at least from a PET layer and an adhesion mediator layer, of melted, whose melting point amounts to maximally 210 DEG C, directly on the one side of the moved tinplate volume,
the tinplate volume is heated up before on such a temperature that it exhibits lying temperature on order behalf of the liquid Kunststoffilmes over the melting point of the adhesion mediator and under the melting point of the tin,
the Kunststoffilm is pressed in slightly to the tinplate volume, by being passed through a gap between two roles, by those the role, which is held Laminatorrolle, resting against the Kunststoffilm, under the fusing temperature of the PET,
the tinplate volume is led around with by the Laminatorrolle lying close Kunststoffilm under tension over a part of the extent of the Laminatorrolle and by the Laminatorrolle over a time of contact or contact length in plant held, which is sufficient, over at a volume speed of at least 50 m/min at least the layer of the PET with a cooling rate of at the most 400 W/m< 2> To cool down DEG C on a temperature, which is at least around 30 DEG C under the melting point of the PET, before the contact between Kunststoffilm and Laminatorrolle is solved,
during a locking subsequent treatment the coated tinplate is heated up on a temperature above the melting point of the PET and the Kunststoffilm by direct introducing of the tinplate volume into a Wasserbad with high cooling rate on ambient temperature is deterred,
It deforms this Ronde by deep-drawing and following Abstreckziehen, whereby the PET layer the deep-drawing and Abstreckziehstempeln is course-turned, to a on one side open, cylindrical dose body, with a cylindrical dose wall and a dose head curved domförmig outward,
Punch out a central opening directly in the domförmigen final part,
Begin a again lockable sealing system with cylindrical fuseholder into the central opening,
Lock the other one, open end of the dose body with a separate, round dose soil out of sheet metal through for flanges and creases under production of a double crease.

2. Procedure according to requirement 1, by the fact characterized that the PET layer was brought in amorphous condition.

3. Procedure according to requirement 2, by the fact characterized that the amorphous condition is obtained by reheating of the coated broad strip on a temperature above the PET melting point and following fast deterrence in the Wasserbad.

4. Procedure after one of the preceding requirements, by the fact characterized that the dose body between the deep-drawing and the Abstreckziehen of a thermal treatment, partly preformed by deep-drawing, is submitted at a temperature from 180 to 200 DEG C.

5. Procedure according to requirement 4, by the fact characterized that the thermal treatment 1 to 5 minutes is accomplished.

6. Procedures according to requirement 1, marked by it that a plastic-coated tinplate is used, with which between the tin surface and the PET layer an adhesion mediator from a thermoplastic plastic it is intended, whose fusing temperature <is/= 210 DEG C.

7. Procedure according to requirement 6, by the fact characterized that the PET and the adhesion mediator are applied by Coextrusion on the tinplate volume heated up, which was heated up on a temperature lying between the fusing temperature of the adhesion mediator and the fusing temperature of the tin.

8. Procedure after one of the preceding requirements, by the fact characterized that forming the dose head at the end of the Abstreckziehens takes place, as the dose body is stripped by means of air pressure of the Abstreckstempel and the air pressure is used to press the final part of the dose body into a stencil with domförmiger recess.

9. Procedure after one of the preceding requirements, by the fact characterized that the dose body at its open end is made smaller by Necken in the diameter, before the dose soil, which exhibits a smaller diameter than the cylindrical dose wall, is up-folded.

10. Procedure after one of the preceding requirements, by the fact characterized that from a cylindrical fuseholder and a one with a flange provided collet existing sealing system is used on one side that the collet is put ago by the inside of the dose body by the central opening of the domförmigen final part, until its flange at the inside of the final part lies close and that onto the part of the collet provided outstanding from the final part with a screw thread the cylindrical fuseholder is screwed.

11. Procedure according to requirement 10, by the fact characterized that a sealing system is used, whose cylindrical fuseholder and collet consist of plastic.

12. Procedure according to requirement 10 or 11, by the fact characterized that the collet is bonded or in-sealed into the final part.

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13. Procedure after one of the preceding requirements, by the fact characterized that a dose soil made of sheet metal is used, which is coated with plastic reciprocally.

14. Procedure according to requirement 13, by the fact characterized that for the dose soil a tinplate reciprocally coated with PET is used.

15. Procedure according to requirement 1, by the fact characterized that the tinplate volume is heated up on such a temperature that it exhibits a temperature lying around at least 10 DEG C over the melting point of the adhesion mediator on order behalf of the Kunststoffilmes.

16. Procedure after one of the requirements 1 to 15, by the fact characterized that pressing the liquid Kunststoffilmes in slightly to the tinplate volume by means of the Laminatorrolle with Kraft of at least 60 N/mm, related to which width of the tinplate volume takes place.

17. Procedure after one of the requirements 1 to 16, by it characterized that the cooling of the Laminatorrolle takes place via water, which by the role is through-led.

18. Procedure according to requirement 17, by the fact characterized that the Laminatorrolle is held by cooling on a temperature within the range of 20 to 80 DEG C.

19. Procedure according to requirement 1, by the fact characterized that the rapid cooling during the subsequent treatment with a cooling rate of at least 1000 W/m< 2> DEG C on a temperature under 20 DEG C takes place.